

REMARKS

The present invention relates to a time of flight (TOF) distance measuring device. Such TOF measuring devices have been long known and used.

In these prior art TOF measuring devices, the measuring device is only operable if the echo from the target clearly lies above the noise level set by the TOF device. The threshold of the receiver, with which the echo pulse is received, therefore lies above the noise level. The closer the threshold is to the noise level, the more likely that noise pulses will be detected and result in false readings for the TOF measuring device. While a certain, small noise rate may be tolerable for these prior art measuring devices, if the threshold is set below the amount that the detector or receiver is blinded by the noise, the echo pulse can no longer be detected.

This, of course, is the approach utilized by U.S. Patent Application No. 2001/0012104 to Dunne. The Dunne device is directed to a time of flight device for measuring distance and, in this case, utilizes a laser emission.

As set-forth in paragraph 59 of the Dunne patent application, Dunne also includes an automatic noise threshold circuit which operates to establish a noise threshold in a manner that it is still possible to detect the echo pulse without the detector being blinded by noise. In other words, the noise threshold established by the automatic noise threshold circuit of Dunne attempts to get as close to, but above, the noise level as possible in an effort to detect weak echos of the transmitted pulse and, by doing so, increase the sensitivity of the detector.

However, in the Dunne device it is still required that the echo pulse lie above the noise level in order for the echo pulse to be detected. Thus, the Dunne patent application is actually

working with two different thresholds, namely the threshold of the noise itself and a second threshold which lies above the noise level. It is that second threshold which is utilized by Dunne to detect the arrival of the echo pulse from the laser emission. Consequently, to that extent, the Dunne device operates substantially like all of the other prior TOF measuring devices, i.e. the reflected echo must have a strength above the noise level in order to be detected.

In sharp contrast to the Dunne patent, the present invention operates in a completely different fashion and a fashion that is clearly defined in all of the claims in this application. More specifically, the present invention utilizes the statistical nature of noise by directly measuring the noise levels and by averaging a considerable number of individual measurements. For example, Figure 5F presents the results of Applicant's invention after 1,000 separate measurements have been processed. Unlike the prior art devices, including the Dunne device, the present invention utilizes a threshold which lies within the noise. That, in turn, allows extremely weak echo pulses to be detected and processed. This is neither taught nor suggested by the Dunne patent application. Rather, in the Dunne patent application, the threshold for the detection of the echo is set just above the noise level.

This aspect of Applicant's invention, furthermore, is clearly and positively defined in all other claims in this application. In particular, the first remaining independent claim, namely claim 33, clearly sets forth the step of "measuring noise" and with the threshold of the receiver lying "in the noise." Claim 33 further clearly defines that the "changes in the noise" caused by the signal pulses are detected.

Although the Patent Examiner has rejected previously submitted claim 33 as anticipated by the Dunne patent application, that rejection is clearly in error and should be withdrawn. As discussed in great detail above, the Dunne patent application simply does not teach or suggest a TOF measuring device having a signal threshold positioned within the noise and in which the changes in the noise caused by the signal pulses is determined by averaging a plurality of individual measurements as set forth in claim 33. While the Dunne patent application does suggest that multiple measurements may be made (see paragraph 52 of Dunne), all of these measurements are made with a threshold positioned above the noise level, not within the noise level as clearly set-forth in claim 33 of the present application.

For the foregoing reasons, Applicant respectfully submits that claim 33, and its dependent claims 34-54 patently define Applicant's invention over the prior art references of record and are, therefore, allowable.

Claim 55 forms the second independent claim in the instant application. Claim 55 is an apparatus claim and clearly defines the invention as including a device having a threshold "lying in the noise" and which threshold is utilized to generate a sequence of logical pulses. Claim 55 then defines the evaluation device which utilizes those logical pulses to determine the distance measurement. Consequently, claim 55, like claim 33, clearly defines the threshold level as lying in the noise, rather than above the noise as shown in the Dunne patent application.

The basis for the Patent Examiner's rejection of claim 55 is not clear from the Examiner's June 11, 2007 Office Action. However, it appears that the Patent Examiner may have intended to reject claim 55 as anticipated by the Dunne patent application. Assuming that that is the case,

for the reasons as discussed above, it is clear that the Dunne patent does not anticipate claim 55. Rather, in sharp contrast to the present invention as it is defined in claim 55, Dunne merely teaches an automatic noise control level to set the threshold just above the noise level, not beneath it as defined in claim 55. For that reason, Applicant respectfully submits that claim 55, and its dependent claim 56-62 patentably define Applicant's invention over the prior art references of record and are, therefore, allowable.

The Patent Examiner, however, has relied upon U.S. Patent Application No. 2004/0135992 to Munro in his rejection of some of the dependent claims in the instant application. However, for the reasons discussed above, independent claims 33 and 55 are allowable over the Dunne patent application so that further discussion of the Munro patent should not be required.

In any event, the Munro patent is really not relevant at all to the instant application. Rather, Munro merely discloses a method and apparatus making use of a coherent burst principal (see paragraph 58 and paragraph 33). This coherent burst technology, at least according to Munro, provides a significant improvement over the phase measuring prior art TOF measuring devices. However, like the Dunne device, Munro neither teaches nor suggests a TOF measuring device which utilizes a threshold set below the noise level and which, through multiple measurements, enables the actual signal to be detected. That, of course, is the essence of Applicant's invention.

Although the Patent Examiner has indicated that claims 56-59 are also rejected, the basis for this rejection is not clear from the Office Action. Further explanation is, therefore, respectfully solicited.

The minor correction to the specification noted by the Patent Examiner has also been made by this amendment.

In view of the foregoing, Applicant respectfully submits that this case is in condition for formal allowance and such action is respectfully solicited.

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Respectfully submitted,

By 

Douglas W. Sprinkle

Registration No.: 27,394

GIFFORD, KRASS, SPRINKLE, ANDERSON
& CITKOWSKI, P.C.

2701 Troy Center Drive, Suite 330

Post Office Box 7021

Troy, Michigan 48007-7021

(248) 647-6000

(248) 647-5210 (Fax)

Attorney for Applicant